(ii) a SOx sorbent component which is BaO; to sorb at least some of the SOx contaminants into the second middle layer and thereby provide a SOx depleted gaseous stream exiting the second middle layer and entering the bottom layer, wherein the bottom layer sorbs and abates the NOx in the gaseous stream; and

(B) in a desorbing period, converting the lean gaseous stream to a rich gaseous stream and raising the temperature of the gaseous stream to within a desorbing temperature range to thereby reduce and desorb at least some of the SOx contaminants from the second middle layer and thereby provide a SOx enriched gaseous stream exiting the second layer.

106-118 (canceled).

REMARKS

Claims 74, 75, 78-82, and 93-105 of the subject application are pending. Applicant has amended claims 74, 82, 95, 102, and 103 in order more particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant has deleted claims 78-81. Applicant has not added any claims. Accordingly, claims 74, 75, 82, and 93-105 are presently being examined.

In view of the following Amendment and Response, applicant respectfully requests that the Examiner reconsider and withdraw the rejections made in the outstanding Office Action.

Support for the Amendments

Applicant has amended claims 74 and 102 in order more particularly point out and distinctly claim the subject matter of applicant's method for removing NOx and SOx contaminants from a gaseous stream. Specifically, applicant has amended independent claims 74 and 102, and the claims dependent thereon, to recite that the first layer further comprises a NOx sorbent component and that the SOx sorbent component in the second layer is selected from the group consisting of $MgAl_2O_4$, MgO, MnO, MnO_2, and Li_2O, wherein the SOx sorbent component has a higher free energy of formation at 350°C than the NOx sorbent component. This amendment is supported at, for example, applicant's specification at page 16, line 21, to page 17, line 10 and page 17, line 16, to page 18, line 5. Applicant has also amended dependent claim 82 to correct the dependency thereof and claims 95 and 103 to correct the antecedent basis thereof. Applicant has entered these amendments in order to overcome the Examiner's rejections.

These amendments to the claims are fully supported in the specification as originally filed, and thus no new matter is introduced by these amendments in accord with 35 U.S.C. Section 132. Accordingly, applicant requests entry of these amendments.

Rejection of Claims 74, 75, 78-81, 95-97 and 102 under 35 U.S.C. Section 102(b) as anticipated by *Feeley et al.*

The Examiner has rejected claims 74, 75, 78-81, 95-97 and 102 under 35 U.S.C. Section 102(b) as being anticipated by United States Patent no. 5,792,436 (*Feeley et al.*). The Examiner states that *Feeley et al.* discloses a method for removing

nitrogen oxides and sulfur oxides from a gaseous stream (column 2, lines 42-53) in the presence of a sorbent material including a composite comprising a first layer comprising a first support and a first platinum component (paragraph bridging columns 2-3), and a second layer comprising an alkali metal or alkaline earth metal oxide, or a transition metal oxide such as manganese oxide or rare earth metal oxides (column 11, lines 13-34). The Examiner argues that *Feeley et al.* teaches at column 8, lines 38-42, that the sorbent material is regenerated by thermal treatment. Regarding claim 75, the Examiner maintains that *Feeley et al.* teaches at column 6, lines 47-51, that the carrier member may be aluminum oxide. Applicant's claims as amended obviate the Examiner's rejection.

In summary, *Feeley et al.* does not teach applicant's concept of a "basicity" gradient in a layered catalyst composite. Applicant's layered catalyst composite comprises a less basic layer (Mg, Mn, Li, etc.) in front of a more basic layer (Ba, Cs, K, etc.). The less basic layer preferentially removes SOx from a gaseous stream before the stream reaches the more basic NOx sorption layer, thereby protecting the NOx sorption layer. When the SOx sorption layer becomes saturated with SOx, the deSOx cycle is begun. The basicity gradient from the top layer to the bottom layer or axially from the front layer to the rear layer are the essence of applicant's invention. *Feeley et al.* does not teach applicant's concept of a "basicity" gradient in a layered catalyst composite. *Feeley et al.* discloses a Sr/Al layer on the top (high basicity) and a Pt/Al layer (low basicity) on the bottom layer.

As set out above, applicant has amended independent claims 74 and 102, and the claims dependent thereon, to recite that the first layer further comprises a NOx sorbent component and that the SOx sorbent component in the second layer is selected from the group consisting of $MgAl_2O_4$, MgO, MnO, MnO_2, and Li_2O, wherein the SOx sorbent component has a higher free energy of formation at 350°C than the NOx

sorbent component. This amendment to the claims is supported applicant's specification as follows:

> As set out above, the present invention employs a second or top layer of a SOx sorbent component which acts as a sulfur oxide absorbing layer to selectively and reversibly absorb sulfur oxides over nitrogen oxides and thereby provide a sulfur guard for the NOx trap component/three-way conversion catalyst. The SOx sorbent component in the SOx absorbing layer is a metal oxide which is less basic than the metal oxide in the NOx absorbing layer. The less basic SOx sorbent component forms SOx complexes (sulfates) that are less stable than the SOx complexes formed with the more basic NOx trap components. The SOx sorbent components of the present invention have a free energy of formation from about 0 to about -90 Kcal/mole at 350°C., preferably from about 0 to about -60 Kcal/mole at 350°C., and more preferably from about -30 to about -55 Kcal/mole at 350°C. The free energy of formation is the free-energy change for a reaction in which a substance in its standard state is formed from its elements in their standard states. The free energy of a system is the internal energy of a system minus the product of its temperature and its entropy, that is G = H - TS, where G is the Gibbs free energy, H is enthalpy, T is absolute temperature, and S is entropy. Figure 1 shows the free energy of formation in Kcal/mole at 350°C. for a number of metal oxides reacting to form nitrates, sulfates, carbonates, nitrites, and sulfites. In general, metals having a free energy of formation with NOx greater than about 0 Kcal/mole at 350°C. (i.e., 10 Kcal/mole) will not readily adsorb NOx while metals having a free energy of formation with SOx lower than about -90 Kcal/mole at 350°C. (i.e., -100 Kcal/mole) will form very stable sulfate but not readily desorb SOx. (applicant's specification at page 16, line 21, to page 17, line 10)
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> ***
>
> The top layer comprises SOx absorbing components which will not substantially absorb NOx under the operating conditions, e.g., from about 300°C. to about 600°C. The medium temperature regeneration

SOx traps selectively absorb SOx so that the SOx traps will not be saturated with nitrate salts in the lean mode and consequently lose their SOx-trap capacity. The SOx sorbent component is capable of selectively absorbing SOx over NOx in a temperature range from about 100°C. to about 600°C. and capable of desorbing SOx in a temperature range from about 500°C. to about 700°C. Preferably, the SOx sorbent component is capable of selectively absorbing SOx over NOx in a temperature range from about 150°C. to about 475°C., more preferably in a temperature range from about 200°C. to about 450°C., and most preferably in a temperature range from about 250°C. to about 450°C. Preferably, the SOx sorbent component is capable of desorbing SOx over NOx in a temperature range from about 500°C. to about 700°C., preferably in a temperature range from about 520°C. to about 658°C., more preferably in a temperature range from about 535°C. to about 675°C., and most preferably in a temperature range from about 550°C. to about 650°C. Nonlimiting illustrative examples of SOx sorbent components may be selected from the group consisting of oxides and aluminum oxides of lithium, magnesium, calcium, manganese, iron, cobalt, nickel, copper, zinc, and silver. More preferred SOx sorbent components may be selected from the group consisting of MgO, $MgAl_2O_4$ (or hydrotalcite with MgO/Al_2O_3 from 9/1 to 1/9), MnO, MnO_2, and Li_2O. The most preferred SOx sorbent components are MgO and Li_2O. (applicant's specification at page 17, line 16, to page 18, line 5)

Applicant's invention, as defined in the amended claims, pertains to a method for removing NOx and SOx contaminants from a gaseous stream employing a layered catalyst composite comprising a first layer and a second layer. The first layer comprises a first support, a NOx sorbent component, and a first platinum component. The second layer comprises a second support and a SOx sorbent component-selected from the group consisting of $MgAl_2O_4$, MgO, MnO, MnO_2, and Li_2O. The SOx sorbent component has a higher free energy of formation at 350°C than the NOx sorbent component.

The present invention relates to a thermally stable, layered catalyst composite of the type generally referred to as a three-way conversion catalyst (TWC). TWC catalysts are polyfunctional because they have the ability to substantially simultaneously catalyze the oxidation of hydrocarbons and carbon monoxide and the reduction of nitrogen oxides. The layered catalyst composites of the present invention have a sulfur oxide absorbing layer before or above a nitrogen oxide absorbing layer. The sulfur oxide absorbing layer selectively and reversibly absorbs sulfur oxides over nitrogen oxides and thereby alleviates sulfur oxide poisoning of the three-way conversion catalyst. Because SOx poisoning of the three-way conversion catalysts is minimized, the layered catalyst composites are able to maintain long term activity and effectively oxidize hydrocarbons and carbon monoxide and reduce nitrogen oxide compounds. (applicant's specification at page 13, line 24, to page 14, line 3)

The *Feeley et al.* reference discloses a method for removing pollutants comprising nitrogen oxides and sorbable components comprising sulfur oxides and phosphorus oxides from a lean gaseous stream. The method comprises (a) in a trapping period, passing the gaseous stream within a sorbing temperature range through a catalyzed trap member comprising a combination of a regenerable sorbent material and an oxidation catalyst, and sorbing at least some of the sorb/able components into the sorbent material to thereby provide a sorbable component-depleted gaseous stream exiting the catalyzed trap member; (b) in a desorbing period, introducing a combustible component into the gaseous stream upstream of the catalyzed trap member and combusting the combustible component in the presence of the oxidation catalyst, the combustible component being introduced in an amount which is limited in order to maintain the bulk composition of the gaseous stream lean but which is enough to heat at least a portion of the sorbent material to within a desorbing temperature range to thereby thermally desorb the sorbable component from the sorbent material and provide

a sorbable component-enriched gaseous stream exiting the catalyzed trap member; and (c) passing the sorbable component-depleted stream to a catalytic treatment zone for the abatement of the pollutants and by-passing the sorbable component-enriched stream around the catalytic treatment zone. *Feeley et al.* at col. 15, lines 15-44

As set out above, applicant has amended claims 74 and 102 to recite that the first layer further comprises a NOx sorbent component and that the SOx sorbent component in the second layer is selected from the group consisting of $MgAl_2O_4$, MgO, MnO, MnO_2, and Li_2O, wherein the SOx sorbent component has a higher free energy of formation at 350°C than the NOx sorbent component. *Feeley et al.* does not teach applicant's concept of a "basicity" gradient in a layered catalyst composite.

Accordingly, the Examiner's rejection of claims 74, 75, 78-81, 95-97 and 102 under 35 U.S.C. Section 102(b) as being anticipated by *Feeley et al.* should be withdrawn.

Rejection of Claims 82, 93, 94, 98-101, and 103-105 under 35 U.S.C. Section 103(a) as being unpatentable over *Feeley et al.*

The Examiner has rejected claims 82, 93, 94, 98-101, and 103-105 under 35 U.S.C. Section 103(a) as being unpatentable over *Feeley et al.* Regarding claim 82, the Examiner states that it would be obvious to employ magnesium oxide or lithium oxide as the sorbent material for the catalyst of *Feeley et al.*, since *Feeley et al.* suggests (column 11, lines 26-31) that any alkali metal or alkaline earth metal oxide may be used. Regarding claims 93 and 94, the Examiner states that it would be within the skill of one of ordinary skill to determine a suitable or optimum concentration for the second layer in the catalyst of *Feeley et al.* Regarding claims 98-100, the Examiner states that it would be obvious to employ lithium oxide or a rare earth oxide as the

nitrogen oxides sorbent component in the catalyst of *Feeley et al.*, since *Feeley et al.* suggests (column 11, lines 27-32) that any rare earth metal oxide or alkali metal oxide may be employed. Regarding claims 103-105, the Examiner states that it would be obvious to employ a third layer for the catalyst of *Feeley et al.*, with the expected result of a more efficient removal of sulfur oxides and nitrogen oxides in the process. Applicant's claims as amended obviate the Examiner's rejection.

As set out above, *Feeley et al.* does not teach applicant's concept of a "basicity" gradient in a layered catalyst composite. Applicant's layered catalyst composite comprises a less basic layer (Mg, Mn, Li, etc.) in front of a more basic layer (Ba, Cs, K, etc.). The less basic layer preferentially removes SOx from a gaseous stream before the stream reaches the more basic NOx sorption layer, thereby protecting the NOx sorption layer. When the SOx sorption layer becomes saturated with SOx, the deSOx cycle is begun. The basicity gradient from the top layer to the bottom layer or axially from the front layer to the rear layer are the essence of applicant's invention. *Feeley et al.* does not teach applicant's concept of a "basicity" gradient in a layered catalyst composite. *Feeley et al.* discloses a Sr/Al layer on the top (high basicity) and a Pt/Al layer (low basicity) on the bottom layer.

Moreover, applicant has amended independent claims 74 and 102, and the claims dependent thereon, to recite that the first layer further comprises a NOx sorbent component and that the SOx sorbent component in the second layer is selected from the group consisting of $MgAl_2O_4$, MgO, MnO, MnO_2, and Li_2O, wherein the SOx sorbent component has a higher free energy of formation at 350°C than the NOx sorbent component.

Accordingly, the Examiner's rejection of claims 82, 93, 94, 98-101, and 103-105 under 35 U.S.C. Section 103(a) as being unpatentable over *Feeley et al.* should be withdrawn.

Obviousness of a composition or process must be predicated on something more than it would be obvious "to try" the particular component recited in the claims or the possibility it will be considered in the future, having been neglected in the past. *Ex parte Argabright et al.* (POBA 1967) 161 U.S.P.Q. 703. There is usually an element of "obvious to try" in any research endeavor, since such research is not undertaken with complete blindness but with some semblance of a chance of success. "Obvious to try" is not a valid test of patentability. *In re Mercier* (CCPA 1975) 515 F2d 1161, 185 U.S.P.Q. 774; *Hybritech Inc. v. Monoclonal Antibodies. Inc.* (CAFC 1986) 802 F2d 1367, 231 U.S.P.Q. 81; *Ex parte Old* (BPAI 1985) 229 U.S.P.Q. 196; *In re Geiger* (CAFC 1987) 815 F2d 686, 2 U.S.P.Q.2d 1276. *In re Dow Chemical Co.* (CAFC 1988) F2d, 5 U.S.P.Q.2d 1529. Patentability determinations based on that as a test are contrary to statute. *In re Antonie* (CCPA 1977) 559 F2d 618, 195 U.S.P.Q. 6; *In re Goodwin et al.* (CCPA 1978) 576 F2d 375, 198 U.S.P.Q. 1; *In re Tomlinson et al.* (CCPA 1966) 363 F2d 928, 150 U.S.P.Q. 623. A rejection based on the opinion of the Examiner that it would be "obvious to try the chemical used in the claimed process which imparted novelty to the process does not meet the requirement of the statute (35 U.S.C. 103) that the issue of obviousness be based on the subject matter as a whole. *In re Dien* (CCPA 1967) 371 F2d 886, 152 U.S.P.Q. 550; *In re Wiaains* (CCPA 1968) 397 F2d 356, 158 U.S.P.Q. 199; *In re Yates* (CCPA 1981) 663 F2d 1054, 211 U.S.P.Q. 1149. Arguing that mere routine experimentation was involved overlooks the second sentence of 35 USC 103. *In re Saether* (CCPA 1974) 492 F2d 849,181 U.S.P.Q. 36. The issue is whether the experimentation is within the teachings of the prior art. *In re Waymouth et al.* (CCPA 1974) 499 F2d 1273, 182 U.S.P.Q. 290. The fact that the prior art does not lead one skilled in the art to expect the process used to produce the claimed product would fail does not establish obviousness. *In re Dow Chem. Co.* (CAFC 1988) 5 U.S.P.Q.2d 1529.

The provisions of Section 103 must be followed realistically to develop the factual background against which the Section 103 determination must be made. It is not proper within the framework of Section 103 to pick and choose from any one reference only so much of it as will support a given position to the exclusion of other parts necessary for the full appreciation of what such reference fairly suggest to one of ordinary skill in the art. The references of record fail to teach or suggest appellant's invention as a whole.

In view of the foregoing Amendment and Response, applicants request reconsideration pursuant to 37 C.F.R. Section 112 and allowance of the claims pending in this application. Applicant requests the Examiner to telephone the undersigned attorney should the Examiner have any questions or comments which might be most expeditiously handled by a telephone conference. No fee is deemed necessary in connection with the filing of this Amendment and Response. If any fee is required, however, authorization is hereby given to charge the amount of such fee to Deposit Account No. 18-1843.

Respectfully submitted,

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